5

# GENERAL HOUSE CHARACTERISTICS

This section presents the findings on general house characteristics, including regional distribution, house size, program participation, construction types, and municipal water and sewage hook ups.

## 5.1 REGIONAL DISTRIBUTION

Homes were surveyed in thirteen of the fourteen counties in Vermont. Comparison to the estimated new homes for 2000 indicates that the geographical distribution may be favoring the northwest. However, further review indicates that any variations in geographical distribution do not appear to have any significant effect on the results of the study.

Table 5.1: Regional Distribution

|                         |     |             | Telephone | Estimated New           |
|-------------------------|-----|-------------|-----------|-------------------------|
| Regions                 | On  | Site Survey | Survey    | Homes 2000 <sup>1</sup> |
|                         | N   | %           | %         |                         |
| N                       | 158 |             | 200       | 2,196                   |
| Northwest               | 103 | 65%         | 61%       | 48%                     |
| Northeast               | 9   | 6%          | 8%        | 12%                     |
| Southwest/South Central | 22  | 15%         | 18%       | 22%                     |
| Southeast               | 24  | 14%         | 14%       | 18%                     |

Although the sample was not specifically designed for comparisons between geographic regions, the data was reviewed to identify substantial variations among regions, to the degree possible considering the small sample sizes. Table 5.2 compares house size, compliance with the RBES code, the penetration of modular homes and the percent of glazing as a proportion of the total wall area across the four regions. House size and percent glazing were chosen as indicators due to the overall trend toward larger homes with more glazing. These characteristics may also be indicators of higher end homes. RBES compliance provides an overall assessment of the thermal efficiency of the homes. Since modular homes have been shown (as discussed below) to be less energy efficient than site built homes, a high penetration of modular homes may be linked to smaller homes and lower RBES compliance.

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<sup>&</sup>lt;sup>1</sup> The estimated number of new homes built in 2000 is from an analysis of the 411 forms collected by the Department of Property Valuation from the towns in Vermont. This analysis covers the same period as the grand lists used to develop the sample frames.

|        |       | Mean  |      |         |         | # Homes                |           |
|--------|-------|-------|------|---------|---------|------------------------|-----------|
|        | # of  | House | Pass |         | Percent | with                   | Median    |
|        | Homes | Size  | Code | Modular | Modular | % Glazing <sup>2</sup> | % Glazing |
| NW     | 103   | 2,489 | 61%  | 17      | 17%     | 87                     | 13.0%     |
| NE     | 9     | 2,265 | 56%  | 1       | 11%     | 8                      | 12.5%     |
| SW     | 22    | 2,929 | 63%  | 4       | 18%     | 22                     | 17.0%     |
| SE     | 24    | 2,247 | 41%  | 5       | 21%     | 22                     | 14.0%     |
| Totals | 158   | 2,510 | 58%  | 27      | 17%     | 139                    | 13.0%     |

Table 5.2: Comparison of General House Characteristics by Region

This analysis indicates that larger homes with more glazing are being built in the southwest section of the state. Both the house size and the mean percentage of glazing are higher for the southwest at the 95% confidence level when compared to the rest of the sample. Other possible conclusions are not as clear. The variations in house sizes in the northwest, northeast and southeast are not statistically significant. The homes in the southeast appear to have complied with the RBES code at a lower level in comparison to the rest of the sample, but this result is barely significant at the 90% confidence level. The penetration of modular homes does not vary sufficiently to conclude that one region has more modular housing than another. The northwest does not stand out as different from the other regions.

To assess whether these geographical variations may affect the results of the study, the mean home size and percent of homes passing RBES were calculated using values weighted to match the estimated actual distribution by region. The weighted mean home size was 2,515 square feet, as compared to 2,510 for the unweighted sample, and the percent of homes passing RBES was 57%, as compared to 58%. These differences are well within the margin of error of the sample.

Most of the survey respondents were living in primary homes and the results of the study are likely to be more representative of this group. Only seven of the homes in the survey were second homes. These homes were distributed throughout the state, with 3 in the northwest, 2 in the southwest, and one each in the northeast and southeast. The Department of Public Service estimates that 15% of the existing housing market is not primary homes. This estimate seems to indicate that it is likely the second home market is underrepresented in this sample. Scheduling on site visits with homeowners who do not actually live in state represents substantial obstacles, which may contribute to their low representation in this study. The subsample of second homes is too small to draw inferences about this population.

### 5.2 House Size

5.1 SIZE AND HOUSE CHARA CTERISTICS

On average, the surveyed homes had 3.1 occupants and 3.2 bedrooms per home.

<sup>&</sup>lt;sup>2</sup> Number of homes where the percent glazing as a total of wall area was available. This information was not available for the 19 homes with previous energy ratings.

The median home size is 2,510 square feet of heated area (excluding garage space) with a 95% confidence interval of 2,284 to 2,545 square feet. The average home size in the 1995 baseline study (2,380) is within this confidence interval. The difference in the means may be partially due to variations in measuring and defining heated space. In the current study, conditioned space included heated basement area that may not be finished, as opposed to the 1995 study in which the area measurements included only living area.

There is a trend toward heating and using basement areas. In the 1995 study, 36% of the homes had heated basements, and finished basements accounted for only 18% of the total homes in the survey. In contrast, the current study shows that about half of the homes had heated basements, and auditors reported that most of these basements had at least some finished area. Nine of the 11 largest homes have heated basements.

| Table 5.3: | Occupany | and Average | <b>House Size</b> |
|------------|----------|-------------|-------------------|
|            |          |             |                   |
|            |          |             |                   |

|                           | Mean  | Median | Minimum | Maximum |
|---------------------------|-------|--------|---------|---------|
| # of bedrooms             | 3.2   | 3      | 2       | 6       |
| # of occupants            | 3.1   | 3      | 1       | 7       |
| Heated area               | 2,510 | 2,390  | 1,067   | 5,340   |
| 1995 study<br>living area | 2,380 | 2,130  | 804     | 8,812   |

The median size home for Vermont Star Homes participants was 2,460 square feet and the average was 2,527. The mean of the Vermont Star Homes group is not statistically different from the sample as a whole.

The table below shows the distribution of the house sizes.

Table 5.4: Distribution of House Sizes

| Area (sq. ft.)    | 2002 Study<br>Heated Area | 1995 Study<br>Living Area | 2002<br>VTStar<br>Only |
|-------------------|---------------------------|---------------------------|------------------------|
| less than 1,000   | 0%                        | 4%                        | 0%                     |
| 1,000 to 1,499    | 8%                        | 12%                       | 9%                     |
| 1,500 to 1,999    | 25%                       | 29%                       | 15%                    |
| 2,000 to 2,499    | 25%                       | 21%                       | 26%                    |
| 2,500 to 2,999    | 19%                       | 11%                       | 30%                    |
| 3,000 to 3,499    | 9%                        | 10%                       | 9%                     |
| 3,500 to 3,999    | 8%                        | 6%                        | 9%                     |
| 4,000 to 4,499    | 3%                        | 4%                        | 0%                     |
| 4,500 to 4,999    | 2%                        | 2%                        | 0%                     |
| greater than 5000 | 2%                        | 2%                        | 2%                     |

HOUSE AND CONSTRUCTION TYPES

#### 5.3 Construction Type

Most of the homes (90%) fell into four categories: cape, colonial, contemporary and ranch. The seven log homes accounted for 4% of the surveyed new homes.

The most common construction type was wood framed, 16" on center (116 homes or 73%). The remainder consisted of wood framed 24" on center (25 homes or 16%), stress skins (8 homes or 5%), log (7 homes) and other (2 homes). All of the wood-framed homes had 2" by 6" walls. In the 1995 study, the stud spacing was not one of the collected data points, so it is not possible to compare these results to the previous survey. It is, however, possible to compare the incidence of log homes and stress skins. This comparison shows the percentage of log homes and homes built with stress skins is fairly consistent.

| Table 5.5: Peneti | ration of Log Hom | es and Homes with | n Stress Skins |
|-------------------|-------------------|-------------------|----------------|
| Construction      | 1995 Study        | 1995 Study        | 2002 Study     |

| Construction | 1995 Study | 1995 Study | 2002 Study | 2002 Study |
|--------------|------------|------------|------------|------------|
| Type         | # of homes | %          | # of homes | %          |
| N            | 151        |            | 159        |            |
| Log          | 5          | 3%         | 7          | 4%         |
| Stress Skins | 5          | 3%         | 8          | 5%         |

**VENTILATION** 

## 5.4 MANUFACTURED AND OWNER-BUILT HOMES

#### 5.1 MODULAR AND OWNER-BUILT HOMES

About 23% of the sample (37 homes) were owner built, which is consistent with the results of the telephone survey (22%). Twenty-seven homes (or 17%) were manufactured homes, either double wides or modular homes, as compared to 16% for the telephone survey. It is possible that both the telephone and on site surveys underestimated the incidence of manufactured housing. Using the on site survey to estimate the incidence of manufactured homes in the market and

The telephone survey may have underestimated manufactured homes because comparison of the overlapping on site to the telephone sample indicates that fewer homes were identified as manufactured on the telephone survey than were verified in the on sites. The reasons for possible undercounting from the on site survey is due to the initial exclusion of double wide manufactured homes set on a permanent foundation (they were included later since the RBES code is applicable) and the identification of manufactured homes through auditors' notes and finding the name of a company making these manufactured homes in the "builder" field rather than as a distinct data point.

setting our confidence level at 95% would lead us to conclude that 17% +/- 6% of the new homes are manufactured homes.

In a number of respects, the efficiency levels of manufactured homes were lower than site built homes. Only about 40% of the manufactured homes in the survey passed the RBES compliance as measured by the VTCheck software, as opposed to over 60% of site built homes. Although the overall incidence of electric water heaters was low, most of these units were installed in modular and owner-built homes. The high saturation of electric stand alone tanks in manufactured homes is likely to be related to the higher percentage of homes with furnaces. Another item of note is that the manufactured homes generally had heating systems with lower efficiencies.

Table 5.6: DHW Fuel Choice and Heating System Efficiencies in Manufactured and Owner-Built Homes

|                      |     |          |        |          |       | Furnaces  | Boilers   |
|----------------------|-----|----------|--------|----------|-------|-----------|-----------|
|                      |     | Electric |        |          | %     |           | % Homes   |
|                      | n   | DHW      | % EDHW | Furnaces | Homes | AFUE<=.85 | AFUE<=.83 |
| Manufactured Homes   | 26  | 7        | 27%    | 9        | 35%   | 100%      | 40%       |
| Owner-Built          | 36  | 3        | 8%     | 2        | 6%    | 50%       | 28%       |
| Builder & Spec Homes | 96  | 2        | 2%     | 12       | 12%   | 0%        | 24%       |
| All Homes            | 158 | 12       | 8%     | 23       | 15%   | 42%       | 34%       |

Although modular homes generally were less energy efficient than site-built homes, they were also significantly smaller and had a lower percentage of glazing in comparison to total wall area, as shown in Table 5.7 below. In contrast, owner-built homes tended to be larger in comparison to the rest of the sample, and nine of the twenty-one homes over 3,500 square feet were built by the homeowner.

Table 5.7: House Size and Percent Glazing for Manufactured and Owner-Built Homes

|                      |         |           |         | Mean  | Median |
|----------------------|---------|-----------|---------|-------|--------|
|                      |         | Average   |         | House | House  |
|                      | # homes | % glazing | # homes | Size  | Size   |
| Manufactured Homes   | 27      | 13.2%     | 27      | 1882  | 1663   |
| Owner-Built          | 36      | 14.9%     | 37      | 2835  | 2492   |
| Builder & Spec Homes | 76      | 14.8%     | 94      | 2562  | 2407   |
| All Homes            | 139     | 14.5%     | 158     | 2510  | 2391   |

BLOWER DOOR TESTS AND VENTILATION ISSUES

#### 5.5 PROGRAM PARTICIPATION

#### 5.1 PROGRAM PARTICIPATION

Homeowners' Perceptions: 47 of the 158 homeowners reported that their homes had been through the Vermont Star Homes program, with 27 claiming that the home received a home energy rating. A total of 18 homes were served through utility programs. The distribution among the programs is given below.

Table 5.8: Vermont Star Homes and Utility Program Participation

|            | Overall | VtStar | Rated Homes |
|------------|---------|--------|-------------|
| n          | 159     | 47     | 27          |
| VGS        | 12      | 12     | 12          |
| BED/VGS    | 4       | 3      | 2           |
| WEC        | 4       | 2      | 0           |
| Don't Know | 21      | 2      | 3           |
| None       | 116     | 26     | 9           |
| Blank      | 2       | 2      | 1           |

According to these customer reports, about 18% of the homes received energy ratings, as compared to about 12% of the respondents to the telephone survey. However, further investigation suggests that information provided by the on site respondents may overstate the number of energy ratings and program participation. Of the 27 customer-reported ratings, 6 could not be verified by Vermont Star Homes. Two of these six were participants in the Vermont Star Homes program but did not receive ratings. Three of the six were identified as VGS participants but could not be verified by VGS.

Direct conversations with two participants and two builders indicates that some builders are claiming that homes have been rated when, in fact, these specific homes did not receive energy ratings. In one case, the builder has a history of participating in the program and constructing homes to the program standard, but another builder has not chosen to participate in the program to date.

It is equally possible that some homeowners are not aware that their homes were served through the program. An initial review by Efficiency Vermont indicates that 3 additional homes participated in the program on some level. Matching the survey participants to program participants is an inexact science due to the different methods of recoding locations.

#### 5.6 ACT 250 AND DEVELOPMENTS

According to participant responses, 30% of the homes in the sample went through the Act 250 process. About 60% of homeowners reported that their homes did not go through Act 250, and the remaining 20% was unsure.

Table 5.9 Act 250 Homes and Homes in Developments

|                  | All H   | omes    | In Developments |         |  |
|------------------|---------|---------|-----------------|---------|--|
|                  | # homes | % homes | # homes         | % homes |  |
| Act 250          | 48      | 30%     | 39              | 53%     |  |
| Non Act 250      | 93      | 59%     | 23              | 31%     |  |
| Don't know/blank | 17      | 11%     | 12              | 16%     |  |
|                  |         |         |                 |         |  |
| Total            | 158     | 100%    | 74              | 47%     |  |

Almost half of the homeowners in the survey identified their homes as located in developments. Of these home, over half were subject to Act 250.

Act 250 homes tended to be smaller than the homes that did not go through Act 250, with a mean of 2370 square feet (median of 2170) for Act 250 as compared to a mean of 2620 (median of 2470) for non Act 250 homes. Only two of the twenty-one homes over 3500 square feet went through Act 250.

### 5.7 FIREPLACES

Almost half the homes (76 out of 159) had at least one fireplace, with 6 homes containing two fireplaces. In 39 homes of these homes, the fireplace(s) had tightly fitted doors, and 46 homes had designated air supply for the fireplace(s).

# 5.8 MUNICIPAL WATER AND SEWAGE HOOK UPS

5.1 MUNICIPAL WATER/SEWE

Of the 159 surveys, 54 homes (34%) were on a municipal water system and 45 homes (28%) were tied into a municipal sewer system.